

REMARKS

The instant Amendment A is responsive to the Office Action dated August 13, 2003. Applicant respectfully submits that claims 1-13 and 15-23 as set forth herein patentably distinguish over the cited references, and respectfully request allowance of all claims.

Applicants request consideration of material submitted with the Supplemental Information Disclosure Statement

Applicants are submitting herewith a Supplemental Information Disclosure Statement in accordance with 37 C.F.R. § 1.97(c), containing Rocklage (U.S. 5,190,477). Applicants request that this reference be considered in connection with the present application.

The current status of the claims

Claims 3-8, 12, 15, 16, 18, and 20-23 were indicated as containing allowable subject matter.

Claims 1, 9-11, and 13 stand rejected under 35 U.S.C. §102(a) as being anticipated by Uematsu et al. of record.

Claims 14 and 17 stand rejected under 35 U.S.C. §102(e) as being anticipated by Frederick et al. (U.S. 6,104,943).

Claim 19 stands rejected under 35 U.S.C. §102(e) as being anticipated by Kwok et al. (U.S. 6,583,623).

Claims 6, 12, 15, and 20, which are indicated as containing allowable subject matter, have been placed into independent form

Claim 6, 12, 15, and 20 have been placed into independent form. Claim 15 has been carefully amended to

resolve the indefiniteness noted in the Office Action. Applicants therefore respectfully submit that claims 6, 12, 15, and 20, as well as claims 7, 8, 16-18, and 21 that depend therefrom, are in condition for allowance, and ask for allowance of claims 6-8, 12, 15-18, 20, and 21.

Applicants request reconsideration of claim 1

Claim 1 calls for applying a first echo planar readout waveform to generate first image data and then a second echo planar waveform to generate T_2 or T_2^* weighted image data, reconstructing to generate a first image representation and a T_2 or T_2^* weighted image representation, and correcting the T_2 or T_2^* weighted image representation with the first image representation.

Uematsu et al. does not disclose or fairly suggest applying first and second echo planar readout waveforms to generate first image data and T_2 or T_2^* weighted image data as called for in claim 1. Indeed, Uematsu does not mention echo planar imaging, EPI, or any equivalent imaging method. In echo planar imaging, an excitation pulse is applied followed by a rapidly oscillating readout gradient waveform. A data line of k-space is read out during each half-oscillation. A large number of data lines, e.g. 64 lines, 128 lines, or more, are read out during each excitation. An entire slice can be generated in one "shot".

In addition to not expressly disclosing EPI, Uematsu et al. cannot be read as suggesting EPI, because the imaging method employed by Uematsu et al. is a line-by-line acquisition technique, in which one data line is acquired after each excitation. EPI acquires a

large plurality of phase encode lines after each excitation. Uematsu et al. acquires images at 2.4 second intervals. The scan time for acquiring an image is given by:

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Image scan time= TR* (p.e. res)*%_k_space* (FOV factor)
                  / lines_per_TR,
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where TR is the repeat time (0.0333 sec in Uematsu), p.e. res is the phase encode resolution (128 lines in Uematsu), %_k_space is the percentage of k-space acquired in each TR (0.75 in Uematsu), FOV factor is the rectangular field of view factor (16/24 ~ 0.666 in Uematsu), and lines_per_TR is the lines of k-space acquired per repetition time TR. These values are taken from page 913, first column, last paragraph of Uematsu. Inserting Uematsu et al.'s values gives:

$$2.4 \sim (0.0333 \text{ sec}) (128 \text{ lines}) (0.75) (0.666) / \text{lines_per_TR}$$

which yields about 1 line per TR repetition using Uematsu's values. Indeed, an image scan time of 2.13 sec rather than 2.4 sec yields exactly 1 line per TR repetition. Those skilled in the art would recognize the slight discrepancy between 2.13 sec and 2.4 sec accounts for starter pulses, software overhead, or other delays that make the time interval for acquiring successive images slightly longer than the image scan time.

Thus, Uematsu acquires a single line of k-space per excitation. This is not echo planar imaging (EPI), because EPI acquires a large number of phase encode lines preferably corresponding to a complete image, for each

repetition time TR. Because Uematsu et al. acquire only a single line per TR, about 2 minutes is required to acquire 50 image sets. (50 images * 2.4 sec per image, as set forth at the top of Uematsu p. 913 middle column).

Where Uematsu et al. acquires one line after each excitation, claim 1 calls for each excitation to be followed by both a first echo planar waveform generating a plurality of data lines and a second echo planar waveform generating a plurality of data lines. Uematsu et al. does not collect two sets of data lines following each excitation.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the anticipation rejection of claim 1, and ask for allowance of claim 1 and of claims 2-5 and 9-11 that depend therefrom.

Applicants request reconsideration of claim 13

Claim 13 calls for a method of contrast enhanced magnetic resonance imaging in which a subject is injected with a contrast agent, magnetic resonance is excited in a region of interest, the excited magnetic resonance is permitted to decay for a preselected duration to optimize one of T_2 and T_2^* weighting, and after the preselected duration an echo planar sequence is applied to generate T_2 or T_2^* weighted data. During the preselected duration, another echo planar sequence is applied to generate T_1 weighted data.

Uematsu et al. does not disclose or fairly suggest acquiring T_2 or T_2^* echo planar imaging data or T_1 echo planar imaging data a selected delay after the excitation. Moreover, Uematsu et al. does not disclose or

fairly suggest using the selected delay to acquire T_1 echo planar imaging data.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the anticipation rejection of claim 13, and ask for allowance of claim 13.

Applicants request reconsideration of claim 19

Claim 19 call for a sequence controller which: (i) induces resonance; (ii) implements a first echo planar readout waveform which generates T_1 weighted data lines; (iii) implements a second echo planar readout waveform which generates one of T_2 and T_2^* weighted data lines, and (iv) controls a sorter to sort the T_1 and T_2 or T_2^* weighted data lines between first and second data memories, and for a reconstruction processor which reconstructs data lines from the first data memory into a first image representation and data lines from the second data memory into a second image representation.

Claim 19 stands rejected as anticipated by Kwok et al. However, Kwok et al. does not disclose or fairly suggest a sequence controller which acquires first and second echo planar readout waveforms and controls a sorter to place the data into first and second memories for reconstruction into first and second images.

Indeed, Kwok et al.'s sole mention of any sort of echo planar technique is in the invention background section at col. 2 lines 32-40:

Recently, an echoplanar spectroscopic imaging technique that produces water, fat and water-plus-fat images without in-plane chemical-shift artifacts is described by Sarkar S, Heberlein K, Metzger G J, Zhang X D, Hu X P,

"Applications of high-resolution echoplanar spectroscopic imaging for structural imaging." (J Magn Reson Imaging 1999;10:1-7). However, this technique suffers from poor SNR and cannot be used for high resolution imaging in clinical settings.

Kwok et al. at col. 2 lines 32-40.

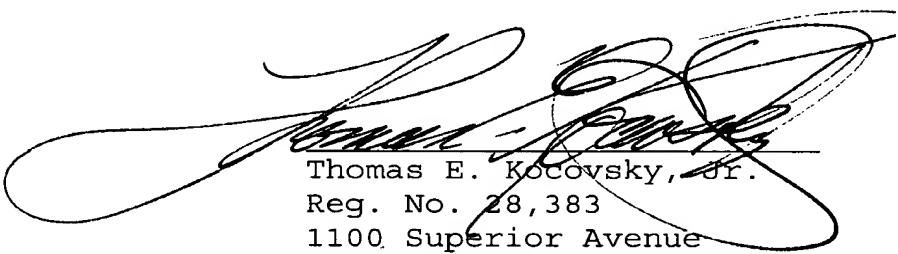
Far from motivating one skilled in the art to investigate using echo planar imaging to acquire T_1 and T_2 or T_2^* weighted imaging data, Kwok et al. actually teaches away from these elements of claim 19 by suggesting that the echo planar imaging provides poor SNR and cannot be used for high resolution imaging in clinical settings.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the anticipation rejection of claim 19, and ask for allowance of claim 19 and of claims 22 and 23 that depend therefrom.

CONCLUSION

For the reasons set forth above, it is submitted that claims 1-13 and 15-23 as set forth herein patentably distinguish over the references of record. Accordingly, an early indication of allowance of claims 1-13 and 15-23 as set forth herein is earnestly solicited.

Respectfully submitted,
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